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TELEVISION AGC AND PICTURE-TUBE VOLTAGE AND SIGNAL SYSTEMS*

AGC Circuits Used in TV Receivers . . . Intercarrier Circuit Designs . . . Relationship of Signal and Voltage to Picture-Tube Operation . . . Characteristics of High-Voltage Systems for Electrostatic and Magnetic Deflection Picture Tubes

In the August issue of The C-D Capacitor, automatic-gain-control systems were described, and a simple agc circuit was shown.

Continuing this analysis, let us now study several commercial examples of agc applications.

RCA 641 System

Quite an elaborate agc system is used in the RCA 641 tv receiver: Fig. 1. In this circuit, the output of the fourth picture i-f amplifier is applied to the plate of the agc detector. A long time constant circuit C_{240} and R_{251} charges up to the peak amplitude of the sync tip. The voltage that appears on the cathode of the agc detector is therefore proportional to the amplitude of the signal sync tip as in the case of the previous agc system, with the exception that a positive charge appears across capacitor C_{240}.

One disadvantage of the simple agc system is that sharp noise pulses will also charge up the capacitor and operate the agc system. Thus, if strong noises are received not only do the noises charge up the agc system, but this additional charge further reduces the amplification of the i-f system and reduces the actual signal strength. Accordingly, not only is the noise present, but the signal strength of the composite television signal is also reduced during the time that the noise is operating the agc system. To prevent this

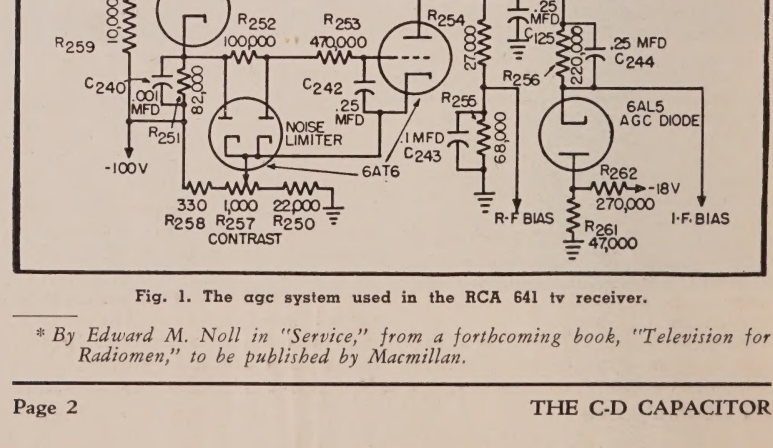

Fig. 1. The agc system used in the RCA 641 tv receiver.

* *By Edward M. Noll in "Service," from a forthcoming book, "Television for Radiomen," to be published by Macmillan.*

defect in the RCA-agc system a noise limiter diode circuit immediately follows the agc rectifier. Sharp noise impulses will cause the two diodes to conduct which will shunt capacitor C_{240} with a law resistance and prevent the capacitor from being charged by the sharp noise impulses. In addition, the large resistor, R_{253}, and capacitor C_{242} in the grid circuit of the agc amplifier will also very effectively filter sharp-noise impulses. Consequently, the voltage on the grid of the agc amplifier will be an essentially constant voltage depending on the average charge placed on capacitor C_{240}. Of course, this average charge is dependent upon the peak level of the continuously received sync tip.

AGC Cathode Bias

The cathode of the agc amplifier tube is biased-negative with respect to its plate, which is at ground or near ground potential. The grid of the agc amplifier is biased by two voltages, one of them the voltage of the negative supply and the other, the positive charge built up on capacitors C_{240}. When the positive voltage across the capacitor is sufficient to overcome the negative voltage from the negative supply (depending on setting of picture control or contrast control of receiver) the agc amplifier will conduct. When this agc amplifier conducts, a voltage drop across R_{254} and R_{255} makes the plate negative with respect to ground. Therefore the negative bias will be applied to the r-f bias line and the i-f bias line. The amplitude of this negative voltage will be proportional to the positive charge on capacitor C_{240} and the positive charge on the capacitor is dependent on the peak amplitude of the received signal. If the setting of the picture control is changed the agc amplifier grid bias will also change and therefore the negative voltage on the r-f and i-f bias lines will also vary. This is a very expedient method of changing the gain of the i-f amplifier and therefore the peak-to-peak amplitude or contrast of the detected signal.

In the reception of the tv signal, signal-to-noise ratio is an important consideration and if the gain of the receiver is to be changed it is better to change the i-f gain and permit the r-f stages to operate at maximum gain because of the improved signal-to-noise ratio. If the signal, however, is exceptionally strong it is possible to overload the first i-f stage in which case the r-f gain must be reduced. The agc system shown does just this: once the signal is of medium signal strength, the i-f gain is affected much more than the r-f gain and the signal-to-noise ratio is sustained. However, when an exceptionally strong signal is received the r-f gain is affected more than the i-f gain. This shift of control is done with the agc diode which, after the diode reaches a certain negative value, conducts and prevents the bias from rising on the i-f bias line, while it continues to rise at a more rapid rate on the r-f bias line. Thus, on a very strong signal the current drawn through resistors R_{255} and R_{254} is the current of the agc amplifier tubes, plus the current of the agc diode and consequently, the bias on the r-f line rises more rapidly.

Summary

In summation, the function of the agc system is to apply an i-f signal to the video detector which is essentially constant for substantial variation in received signal strength. This is accomplished by rectifying an agc-control voltage which is proportional to the amplitude of the i-f signal during the sync tip.

Special I-F and Video System

A special i-f and video system called an intercarrier system, has been developed by G.E. In this system, Fig. 2, the picture and the sound are carried through the picture i-f and video amplifiers up to the grid of the picture tube. Only one i-f system is necessary. The sound is taken off a tuned-circuit located between the video output and the grid of the picture tube which is tuned to 4.5 mc. The sound is then passed to a conventional limiter-discriminator and audio system.

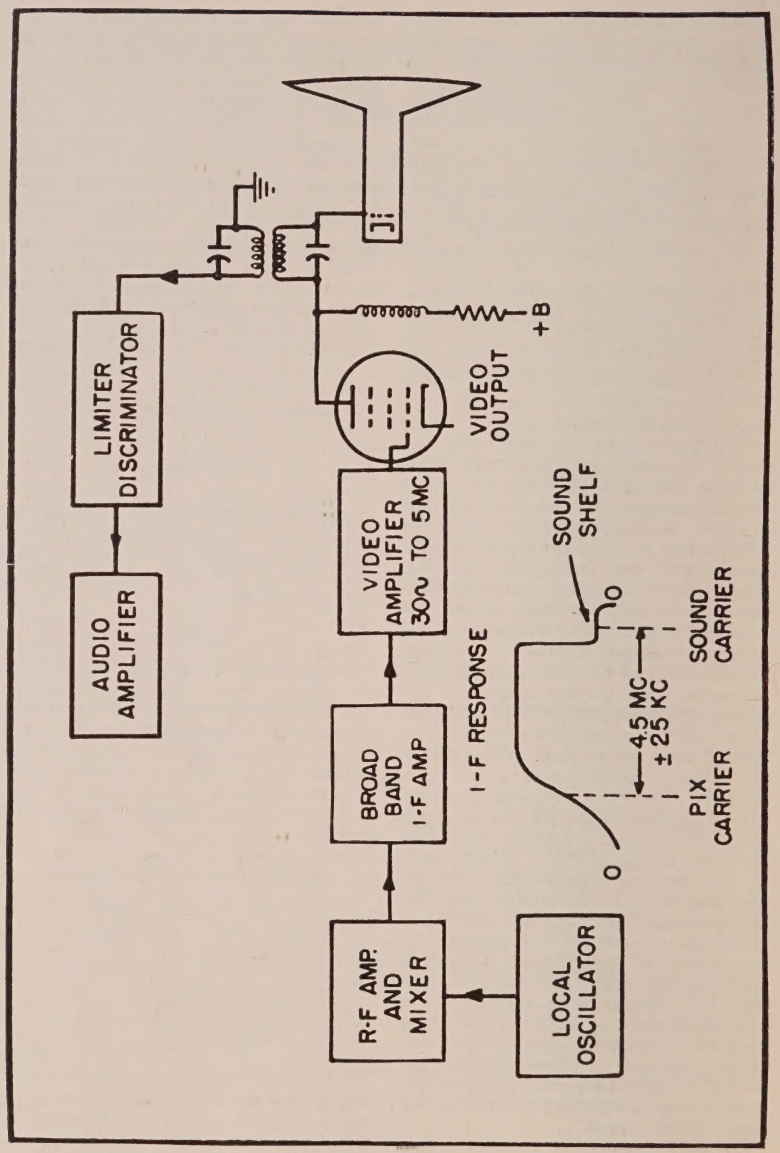

Fig. 2. Intercarrier system used in the G.E. tv receiver.

Video-Sound Carrier

Actually the 4.5 mc, to which the parallel resonant circuit is tuned, is the original megacycle separation between the picture and the sound carrier. In other words, in transmitting such a broad band of frequencies through the i-f, the frequency-modulated sound carrier looks just like another component of modulation to the picture carrier and the video detector. To make sure that the picture carrier always dominates at the video detector, the i-f system is detuned very much at the sound carrier and the sound carrier appears on a shelf in the response curve as shown in the figure. Inasmuch as the sound carrier is frequency modulated, the megacycle separation between it and the picture carrier is not always 4.5, but varies 4.5 mc, ± 25 kc. Consequently, there is a frequency-modulated 4.5 mc center frequency in the parallel-resonant circuit which is detected as the sound. The parallel-resonant circuit in series with the picture signal path prevents the sound from appearing on the grid of the picture tube. Oscillator tuning is not critical because the sound i-f frequency is dependent on the megacycle separation between picture and sound carrier and this is independent of the setting of the local oscillator. Since the picture i-f system is so very broad the setting of the local oscillator is not critical.

Picture Tube Voltage and Signal Circuits

A number of a-c signals and d-c voltages must be applied to the electrodes of the picture tube. The three a-c signals are picture and blanking to the control grid, and vertical and horizontal sawteeth to the respective deflection systems. A variable d-c bias voltage must also be applied to the control grid and the proper potentials must be applied to the elements of the electron gun. In addition, it is necessary to have a d-c component of deflection voltage or current to properly center the entire picture on the scanning raster.

The various signals, voltages, and currents necessary to properly operate a magnetically deflected picture tube are indicated in Fig. 3. Signal voltage is of course applied to the control grid of the picture tube to modulate the electron stream in accordance with the light variations, and to shut off this electron beam during the retrace intervals of the scanning process. Sawtooth-signal current in the horizontal and vertical deflection coils produce the changing magnetic field which causes the beam to scan across and down the screen. The electrode voltages for the cylindrical elements of the electron gun are generally taken off a bleeder divider across a high-voltage power supply. The grid is the most negative electrode of the gun and it is either at the low potential end of the bleeder system, or a separate low-voltage power supply source is used to set the grid negative with respect to the cathode. A d-c component of current also passes through the deflection coils to properly center the electron stream. In addition, the magnetic field generated by the focusing coil and the ion-trap coil must be formed with a component of d-c current generally taken off the low-voltage power supply. As can be seen, proper operation of the picture tube circuit is dependent on a number of signals and voltages which must be properly set in level and amplitude to obtain a satisfactory picture.

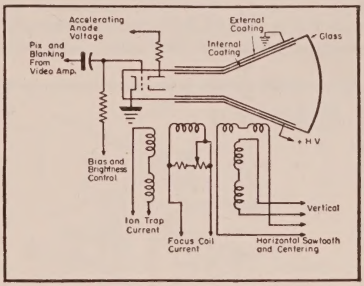

Fig. 3. Picture tube circuit for magnetic deflection and focusing.

When electrostatic deflection is used, Fig. 4, a similar picture and blanking voltage must be applied to the control grid, and sawtooth voltages of the proper horizontal and vertical repetition rate must be applied to the deflection plates. The electrode potentials for the electron gun and the deflection plates are generally taken off a bleeder across a high-voltage power supply. One deflection plate is always at second anode potential and its companion plate can be raised above or below the second anode voltage by means of the centering control. Consequently the picture as a complete unit can be moved right or left, or up and down, to properly center the picture on the face of the tube. Generally

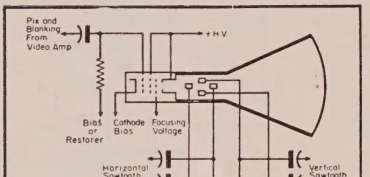

Fig. 4. A picture tube circuit for electrostatic deflection and focusing.

the d-c component of grid voltage which sets the average brightness is obtained from a divider system across the low-voltage power supply, applying positive voltage to the cathode of the picture tube. So far as grid signal is concerned, it is simply a voltage variation. Inasmuch as little power is required in pitcure-tube circuits, components can be made at a reasonable cost and without excess weight. To generate a magnetic field of sufficient strength to deflect the beam its full sweep horizontally requires some power, and horizontal-deflection current required sometimes approaches a half of an ampere.

High Voltage Systems

A high accelerating potential is necessary to generate the high velocity scanning beam of the cathode-ray picture tube. Although the potential necessary is in the thousands of volts the actual current drawn at this high voltage is relatively small. Thus it is possible to construct a satisfactory high-voltage supply for picture-tube operation with relatively small parts, which do not add excessively to the weight and area of the receiver chassis. A number of systems are being used presently in the modern tv receiver. There are only a few current tv models which use a high-voltage transformer excited by the 110-volt primary-line voltage. Most of the receivers rectify the peak amplitudes of some oscillating or transient voltage as their source of high voltage d-c potential. This system has been found very practical because the very minute current drawn does not appreciably load the transient voltage source or in any way affect the operation of the circuit to which the transient is associated.

The current requirements of the average picture tube is extremely low and the very peak instantaneous current is less than one milliampere. The low current requirement means that the size of the parts can be kept small and a simple filter system, consisting generally of only a resistor and a pair of capacitors can very effectively filter the rectified voltage. If the time constant of the filter capacitors and resistor is kept sufficiently long to prevent any appreciable discharge of the capacitor, between conducting periods of the high voltage rectifier, a well-filtered high voltage source is obtained.

When electrostatic deflection picture tubes are used, a series of resistors are connected across the high-voltage source and the various electrodes of the picture tube are tapped off at appropriate points to obtain their correct potentials. The current drawn by the picture tube, and the current passing through the bleeder resistor represents

the load placed on the high voltage supply. In practice the values of the resistors in the bleeder network are relatively high and bleeder current as a result is always less than one milliampere. In those receivers, where the picture tube is focused and deflected magnetically there is no bleeder system across the high-voltage supply, high-voltage supply only furnishing the second anode potential. Proper potentials for the accelerating grid and other low-voltage electrodes of the picture tube are obtained from the low-voltage supply. As a result there is an extremely light load on the high-voltage supply system because of the absence of a bleeder network, plus the fact that the only potential required is that which is applied to the second anode of the picture tube.

To prevent focusing instability and variation of correct focusing point, with changes in brightness setting, it is necessary that the high-voltage supply system have good regulation. Good regulation, of course, can be obtained by keeping a constant load on the high-voltage supply which does not vary appreciably with the changes in the picture tube beam current. This can be accomplished by using a bleeder network which draws appreciable current from the high-voltage system. Of course, the greater the current drawn the higher the ripple voltage becomes and stricter filter requirements are necessary. If magnetic deflection and focusing is used there is no interaction between focusing and the high-voltage systems.

In the transient and oscillating-voltage system, the base ripple frequency is much higher than when a high voltage transformer is used and consequently it is filtered with greater ease by relatively small value capacitors. This expedient also makes the high-voltage supply less hazardous because the small capacitors cannot accumulate as high a charge as the larger capacitors needed to filter low-frequency 60- to 120-cycle ripple.

The transient voltage supply is an economical and effective means of obtaining the 8,000 to 10,000 volts required for optimum operation of the tv picture tube. Decidedly fewer component parts are required and the expensive and hazardous high voltage transformer is unnecessary. The filtering requirements are not as strict because of the higher ripple frequency. This means of obtaining the high voltage also presents a safety feature so far as the operation of the picture tube is concerned, because if there is a failure of horizontal sweep voltages, the high-voltage second anode also fails at the same time and an extremely bright spot does not appear on the fluorescent screen.

If the high voltage system is to be operated at peak efficiency it is necessary that the load on the system be

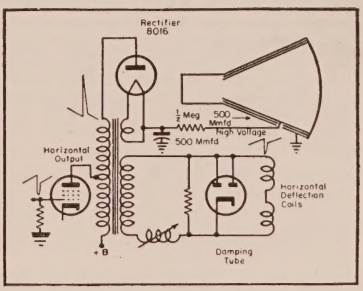

Fig. 5. A flyback high-voltage supply.

kept extremely light and consequently dielectric losses and arcing losses must be kept at a minimum. Rounded corona shields are used at many connection points in the high-voltage system. As the potential requirements become increasingly higher the corona and spark-discharge problems become more acute. In projection tv receivers we have this problem, since picture tube voltages here are as high as 30,000 to 90,000 volts.

A transient or fly-back voltage supply is a part of the horizontal deflection output circuit and utilizes a transient voltage generated in the horizontal deflection coils to supply the high-voltage potential for the picture tube. A typical transient-voltage supply is shown in Fig. 5.

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WANTED—Aerovox LC checker. Will pay cash or swap equal for Supreme 542 multitester, O. S. Marder, 1694 Selwyn Ave., Bronx 57, N. Y.

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WANTED—Roll film adapter, 120 or 620 to fit 6x9 cm film pack camera. For sale, 1947 G.E. model TC3 tube checker. Arnold L. Halpen, 34 Second Ave., Long Branch, N. J.

FOR SALE—Philco light beam replacement parts. Reproducer arm, less parts, jewel, armature & frame assem., lamp, light-sensitive cell, tube & lens assem. All like new, half price. Victor Kozma, 3104 Wilkinson Ave., New York 61, N. Y.

FOR SALE—3″ reflecting telescope and tripod, mirror needs resilvering. Valentino, 1714 - 76 St., Brooklyn 14, N. Y.

FOR SALE—Microphones. 1 70D Amateur and P.A. crystal $5, 1 74B hi-fidelity crystal $6.50, 1 720B B.C. hi. fi. $20 F.O.B. Chicago. Paul H. Prokes, 9216 Menard, Oaklawn, Ill.

SELL—Misc. radio parts and supplies. Want small to med. cal. pistols, no junk. Must be reasonably priced or factory new. Edward Howell, General Delivery, Gastonia, North Carolina.

WANTED—Two tubes, type 1A7G. (Not 1A7GT) Dale Kelly, RFD 3, Bethlehem, Pa.

SALE—New WRL Globe Trotter xmitter, complete for 80, 20, and 10. Won in contest. $75 or best offer. Three element 10 meter beam $10. E. Harris, 3319 Catalpa Ave., Chicago 25, Illinois.

SALE OR TRADE—G.M. 1941-42 auto radio, used, push button solenoid frozen. Want FM, FM-AM, or all wave tuner, or sig. gen. J. Rosse, 235 Garfield Ave., Jersey City, N. J.

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FOR SALE—NC-46 Com. rec. Brand new with matching speaker, and instructions. First $79.50 takes it. Leroy Musselwhite, PO Box 438, China Grove, N. C.

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FOR SALE—Spot freq. sig. gen.; 12 pretuned freq. Model 200 by the Electronic Co. $20. John R. Grimm, 52 Conway St., Carlisle, Pa.

FOR SALE—RCA console model 6K $15. Silvertone model 1827 $10. Farnsworth 3-way port. model BT-68 $20. Table model BC $10. John Kozma, 3104 Wilkinson Ave., Bronx 61, N. Y.

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FOR SALE—Triumph No. 351 multimeter, 5,000 ohm per volt, 1,500V. DC 600V. AC 5 megohm 150 ma plus 52 DB ranges. Almost new. $15. W. J. Remer, 5904 S. Princeton, Chicago 21, Ill.

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FOR SALE—3 tube AC-DC amplifiers with tone control (no tubes or speaker),$2.50 FOB. Pop. Science, Pop. Mechanics, Radio news, and other radio magazines and books. Also Precision 954G portable tube tester and vom. $90. T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

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FOR SALE—Hickok dynamic mutual conductance multi tester model 534, used 1 mo. $110. Also will swap DeForest training course for signal gen. or 16mm projector. Wayne Mumma, 428 York Ave., N. W., Warren, Ohio.

FOR SALE—Triplett tube tester, model 1621 $20. Philco transitone car radio, model C-1450, less head, $15. Supreme 502 tube set tester with instruction book $30. Richard C. Pressey Sr., 479 Tonnele Ave., Jersey City 7, N. J.

SWAP—Practical Electrician's Course (I.C.S.) and Rider's manual No. 1 for good signal gen. Lessons and manual in A1 condition. Original cost of Electrician's course $105. Robert G. Hoffman, 246 N. Sec. St., Lykens, Pa.

SELL OR SWAP—Clough-Brengle dynatest tube tester, model 125-A, good condition. $30. or swap for Vols. X and XI Rider's. Richard Eagle, 1411 Beaver Ave., Orlando, Fla.

FOR SALE—Test Rite model B45 sig. gen. Range, 150KC thru 50MC. New condition with instructions and circuit diagram. Bat. operated, stable output. $20 Also 1 Ghirardi radio physics course like new, $3 PP. H. Hickey, Box 196, Benld, Ill.

FOR SALE—5" model KT5 Andrea television set. 3 stations. $60. Or swap for testing equip. Henry Bullmann, Bradly Gardens, RD 4, 101 Oak St., Somerville, N. J.

SELL OR TRADE—New unused ultra-high freq transceiver, model BC645, not in operating cond., but with complete instructions. Will swap for used transceiver or receiver in operating cond. B. Weinstein, 559 Hopkinson Ave., Brooklyn 12, N. Y.

FOR SALE—BC342C 110V. AC type rec. Range, 6 bands 1.5 mc to 18mc, 2 stages RF, 3 stages IF, crystal filter, BFO, perfect condition. $60. Also sig. gen. model A-200 used slightly. $40. Leo Packer, 2197 East 21st St., Brooklyn 29, N. Y.

TRADE—Philco sig. gen. for photo enlarger, any type. Must be in good operating condition. All letters answered. Mike Unger, Jr., 3038 E. 75 St., Cleveland 4, Ohio.

FOR SALE—New Revere 8mm projector with case and Voigtlander Bessa, f3.5, 1/400 sec., with accessories, like new. Best offer for either or both. Bert Rashkow, 2133 E. 33 St., Brooklyn 10, N. Y.

FOR SALE—Sprayberry Radio and Television course. Approx. 100 lessons. Includes diagrams, schematics, etc. Cost over $100. Make offer. "Metz," 2114 Himrod St., Brooklyn 27, N. Y.

WANTED—CX301A, CX300A, CX112A or CX371A radio receiving tubes in pertect operating condition. What's your price? John G. Morria, 167 Myrtle Ave., Staten Island 10, N. Y.

SELL OR TRADE—Have complete darkroom, enlarger, printer, tanks, trays, etc. Wish radio equip. testers, parts or cash. David Alcaide, 368 School St., Belmont, Mass.

FOR SALE—Model K8 (Presto) professional recorder, complete in portable carrying case with speaker in lid. Like new, used only about 30 hrs. Any reasonable offer accepted. D. Bernard Fritz, Bethlehem Pike, Colmar, Pa.

TRADE—Postage Stamps. Attention, collectors specializing in a particular foreign country who have duplicate stamps to exchange. G. M. Costes, 1308 Powell St., San Francisco 11, Calif.

FOR SALE—Philco 7050 tube tester, $40. RCA 195A voltohmyst, $70. Supreme 576 sig. gen., $60. Perfect condition. All $150. E. W. Dillon, Jr., Saratoga, Wyo.

FOR SALE—Miscellaneous Radio Parts. Send for list. H. F. Post, 2620 N. Monticello Ave., Chicago 47, Ill.

SALE OR TRADE—Delco power plant, four cycle gas engine driving 300 watt 12-15V dc generator, $45. LM-7 freq. meter with modulation, $25. Trade for audio, recording , or test equipment. J. Bradley, 430 Harvard, Ontario, Calif.

FOR SALE—BC348Q in fine condition converted per QST issue with external power supply and extra output amplifier built into rec. with 5" speaker, $60. Kelly's Radio Service, Box 474, RFD 1, Akron 12, Ohio.

FOR SALE—Miscellaneous radio parts. Send for list. Melvin Okin, 915 Bryant Ave., New York 59, N. Y.

FOR SALE—Home constructed volt-ohm meter in very good condition. Complete with meter leads, $18. Jim Gaston, 57 Tuxedo Road, Montclair, N. J.

SALE OR TRADE—Motorola car radio less control head; 3½ h.p. Waterwitch outboard motor, Need 16 mm sound projector or what have you? Charles A. Crowther, 219 Garfield Ave., Syracuse, N. Y.

FOR SALE—If you have suffered through lack of sales, use my mailing lists to sell those sets. 100,000 names in every locality. Lowest rates. Gerald Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

FOR SALE—Miscellaneous radio parts. Send for list. Joseph D. Constantino, 297 Sumner St., E. Boston, Mass.

FOR SALE—Radio City Model 410 Multitester; Superior Instrument Co. Model 450 Tube tester; Modern Radio Servicing—Ghirardi; The Oscillator at work—Rider; and other books. First class condition. Howard L. Leece, 143rd St. at 104th Ave., Orland Park, Ill.

FOR SALE—Variable Condensers for BC 314. Excellent for high fidelity superhet receivers. $2.50 each. David T. Armstrong, 221 Angelique Street, Weehawken, N. J.

FOR SALE—RCA remote control amplifier, 25 watt 2 mic input 2 phono inputs; 1 RCA mike and stand; 150 ft. remote control cable; 2 12 inch 15 watt speakers and baffles. All in perfect condition. Van's Radio Sales, 1718 S. Westnedge Ave., Kalamazoo, Mich.

WANTED—Oct., 1946 edition of QST. Will pay your price and postage. M/Sgt. C. Guido D4AVR, 92nd Air Repair Sqdn., O.A.D., APO 61, c/o PM New York, N. Y.

FOR SALE—Model 3212 Triplett tube tester. Unit guaranteed, $30 with all instructions. Vern Greiveldinger, Hanover, Kansas.

WANTED—1946-47 buckram bound The Radio Amateur's Handbook, must be in very good condition. Will pay $1.50 ea. Stephen Bauman, 61 Market St., Passaic, N. J.

SELL OR SWAP—10 x 15 printing press, 30 cases of type, inks, stone, complete printing outfit. Want test equipment, radio, electrical, or good television set or kit. Stanley Zukowski, 808 Swayne Ave., Lindhurst, N. J.

FOR SALE—Very small foreign camera,, "Micro." f4.5 lens, shutter speeds 1/25, 1/50, 1/100 and bulb. Including case $11.50. For information send 3c stamp to: Martin Cohen, 1325 East 22nd St., Brooklyn 10, N. Y.

WANTED—Schematic diagram and construction data for building high fidel. amplifier of 15 watts. Prefer direct coupling circuit with inverse feedback, push-pull power output, No hum. Clyde W. Wimer, R 800 Wampum Ave., Ellwood City, Pa.

SWAP OR SELL—3E29 xmtr tube new; Sunbeam shavemaster electric razor like new; 3 VR 90 tubes, $20. Other parts and tubes. Want used sig. gen. What do you need? Howard Keilholtz, 600 S. Camp Meade Rd., Linthicum Hgts, Md.

FOR SALE—Aetna change rack. ATR type 60 6.3V supply 6.5amp. Best offer takes either. C.O.D. plus shipping charges. Robert Greenmen, 518 Liberty St., Aurora, Ill.

TRADE—Crosley 86CS 8 tube comb. FM with record compt. Demonstrator, for Rec-O-Cut 16" Recording mechanism. Howard 906CS Armshair comb. $100. Telechron Radio-Alarm $17.50. Emerson 1002 Radio with hearing aid, $32. Eilers' Radio Service, Gladbrook, Iowa.

FOR SALE—Model BK-501 Brush Mail-A-Voice recorder and reproducer. $25. Shakespeare Co., 506 Assembly St. Columbia, South Carolina.

WANTED—Old issues of Modern Electrics, Popular Electricity, Q S T 1919 and 1920. Cash or will swap for other old issues. J. T. Lipani, 157a Leverett St., Boston 14, Mass.

SWAP—National NC-46 perfect condition for 1946 model Hallicrafters S-39; or EC-1A Echophone plus either DB-22A preselector or HT-17 xmitter. Anthony Russak, Box 41, Hastings-on-Hudson 6, N. Y.

SWAP—Phillips AF7 and AB2 miniwatt tubes. Also have Sept., Nov., 1946 to March, 1947 QST. Need May, 1947 QST. What have you? John D. Grow, 7712 Westmoreland Ave., Swissvale, Pa.

SALE OR TRADE—National rec., model 100A, phones and speaker, A-1 condition, $150. Hensoldt Wacht binocular, 12 x 30, cowhide case, good condition, $100. National Schools Radio Course, incl. power supply and other equip., $100. A. F. Fiogge, 5064 W. Imperial Hwy., Los Angeles 45, Calif.

FOR SALE—304-TL tubes in carton, $2.19 each. Full wave meter rectifiers with complete wiring instructions for making AC-DC voltohmeter from 0-1 ma. meter, $1.29 each. Include 10c postage. Case Electronics, Box 1145, Pasadena 20, Calif.

FOR SALE OR TRADE—1940 Pontiac 7-tube auto radio, $40; 4-tone Play-A-tune auto horn, instructions, $12; 2¼ x 3¼ Speed Graphic and acces., $225. Guy Wong, 2121 Lovis Road, Palo Alto, Calif.

FOR SALE—Dumont Model 274 Scope, used 10 hours, data and instructions included, shipped in orig. carton. Make offer or $80 cash. Daniel J. Gauthier, 27 Park St., Box 727, Tupper Lake, N. Y.

WANTED—Silent or sound 16 mm films, features, etc. Jim Crawford, 1842 Garfield Rd., East Cleveland 12, Ohio.

SELL OR TRADE—R.M.E. DB20, $29; Girardi's Radio Trouble Shooter's Handb'k, $3; Heavy duty wind-up phono motors, $5; National HRO-M rec. with power, $145. Want, Oscilloscope at Work. A. Livingstone, 12-01 Ellis Ave., Fair Lawn, N. J.

FOR SALE—100 watt cw phone xmitter, 10 to 160 meters, complete with crystals, pair 809's in final. 4 used RCA 60W trumpet speakers, part no MI-6255. Eugene M. Hess, 2901 Oakland Ave., Ames, Iowa.

FOR SALE—FM Pilotuners used as demonstrators, like new, instructions incl. Less than list price. W. E. Ulbright, 851 Lincoln Way East, Mishawaka, Indiana.

SELL OR TRADE—Silver 906 sig. gen.; Radio City Prod. vacuum tube voltmeter; 30W P.A. amplifier; Army radio rec., No. 100/URR. Want good still camera or 8 mm movie equip. Harold Rose, 664 Comelia, Chicago 13, Ill.

FOR SALE—Sept 35 mm camera in perfect condition, takes stills and movies. Also Philco auto radio model 928 K, perfect condition. Cash or make offer. Troy S. Starr, 29 Rosedale Drive, Binghampton, N. Y.

SELL OR TRADE—Halicrafters SX25 fair condition; BC645 never used; $85 for both. Want 16 mm motion picture projector or what have you? Harry Keeley, 122 South Maple Ave. Oak Park, Ill.

FOR SALE—Miscellaneous old radio and auto parts, send list of what you want. Abery Radio, 35 Colonial St., Hartford 6, Conn.

FOR SALE—Meissner 3 tube regen. rec., 550 KC to 15 MC, complete with tubes, $8.50. Otto Pollei, Jr., 2122 Edgeland Ave., Louisville 4, Kentucky.

WANTED—Projector, 8 mm, state condi., make, model and price. Will sell or trade German Foth Derby f2.5, shutter to 1/500 and German folding Agfa, f4.5, Solinar lens, compur shutter to 1/300, 116 film. Jack Heller, 2643 N. Washtenaw, Chicago 47, Illinois.

WANTED—4 x 3 Speed Graflex camera, any lens, any condition, for cash. Seller must be willing to permit inspection. Max Alth, 261 Riverdale Ave., Yonkers, N. Y.

FOR SALE—RCA Radiola 18 table model, beautiful cabinet, perfect playing condition, separate speaker, 7 tubes. Best offer takes it. B. Sunshine, 85-17 167th St., Jamaica, L. I., N. Y.

FOR SALE OR TRADE—Radio parts, tubes ham gear of all descriptions. Write for listing. Will trade for anything. Jack Gentle, Route 3, Piedmont, S. C.

SELL OR TRADE—Automatic Devil Dog burglar alarm for small AC-DC 5 tube radio set. John Mata, 1862 So. Normal Ave., Chicago 16, Ill.

TRADE—Radio parts, tubes, multi-conductor cable, chemicals for 16 mm movie films. What have you? C. K. Jewell, Box 342, Gambier, Ohio.

SALE OR TRADE—Meissner sig. shifter, de luxe; Weston ohm-meter, read to 1/10 ohm; Simpson pocket type battery tester; Simpson pocket type DC miliammeter, 1-1,000 mils DC; Need new and used radio parts, esp. tubes. E. L. Peterson, Monista, New Mexico.

FOR SALE OR SWAP—Two photo-elec. cell outfits, complete with 6 and 110V relays; portable phonograph with records; car radio; cameras; 6,000V neon xformer; 32 cal. revolver. Want radio parts. Reed B. Gillette, Sharon, Connecticut.

WANTED INFORMATION—Where may I purchase negative temp. coefficient resistors abt. 1,500 ohms cold 250 ohms hot 5W? George Drab, Jr., RFD No. 1, Fort Plain, N. Y.

FOR SALE—Meissner Analyst, attachments and instructions, $85; Bliley crystal cont. oscillator with instructions, $55; Simpson mod. 305 tube checker, $35. G. R. Bell, 512 E. William St., Ann Arbor, Mich.

FOR SALE OR TRADE—Complete radio service. Newest electronic lab. Americas foremost instruments. Manuals, N.R.I. Course, replacement parts etc. Valued $700. Want 1939 car, sedan. Terry Radio Service, 217 W. Shadeland Ave., Pleasantville, N. J.

SELL OR TRADE—Factory rebuilt No. 530 Hickok tube tester; Supreme 555 Diagnomoscope, (all wave sig. gen. and 3" scope mounted in one case); Cash. Also camera, fishing gear, lathe. M. Gordon, 140 Washington Ave., Vandergrift, Pa.

FOR SALE—10 gross bakelite 4-prong standard tube-bases for electronic tubes, etc., $29.75. J. H. Browne, 3774 Surf Ave., Brooklyn, N. Y.

WANTED—Standard gauge Lionel electric trains. Locos, cars, switches, etc. Paint not important, otherwise in good cond. Buy outright or trade radio parts. N. F. McNally, 84 Greene, Pawtucket, R. I.

FOR SALE—Thordarson transformer, output no. T17S15, like new, $9; 2 new 40m vibrator transformers in the orig. cartons, $2.50 ea. Cleo Dennis Radio, R 6, G5364 Stanley Rd., Flint Mich.

FOR SALE—Motor-generator rig in excellent condition. Gen.: 9V DC output at 1,800 RPM, Mfg. by Master Electric Co. Continuous Duty Motor: 1/4 HP, 1,750 RPM. Units mounted; ready to operate. $20. George Tyler, Pine Orchard Road, Branford, Conn.

FOR SALE—National NC-46 and speaker, $75; Millen R-9'er, $18; Supreme 504-A tube-set tester, new metal case, $60; RCP 446 multitester, 1,000 ohms/volt meter, $14. All perfect. Martin Herbstman, 1806 Sterling Place, Brooklyn, N. Y.

SALE OR TRADE—12" Crosley dynam. speaker and output trans; 10" dynam. speak. and output trans; phono. motor turntable, 9", 110V AC; pickup with cartridge. Need 6V power pack deliv. 1.5A, 180V DC from 110V AC. I. Herman, 29 Gallatin St., NW, Washington 11, D. C.

FOR SALE—Rider's Manuals, 10 and 11, excellent condition, $12 each. Postage prepaid. John Deavereaux, 940 Everett St. El Cerrito, Calif.

FOR SALE—2 tube Meissner student set, good condition, with cabinet and speak. $10. Jim Burke, 1950 Hopkins St., Berkeley 7, Calif.

FOR SALE—Rider Manuals, 6 thru 13, in new condition. Over $200 worth new parts with Superior model 400 multimeter. All for $150. Messiner recorder, $100. Paul M. Jenks, Jr. 417½ S. Gillespie St., Pampa, Texas.

FOR SALE—Clough-Brengle audio gen., model 180-H, 20-34,000 cycles; Motorola FM rec., model FM13V, with instructions, less control head; Portable G.E. mercury vapor lamp with transformer. Wilfred D. Jones, 905 Penna, Ave., Colton, Calif.

FOR SALE—Tubes: 1F5, 1H6, 1LB4, 1LC5, 1LD5, 6L6, 27, 31, 39-44, 42. Standard brands, (not war surplus). Mailed postpaid, 25% off list price. Clark Causey, Route 1, Liberty, N. C.

FOR SALE—Radio text books current publications, beginners and advanced, reasonable, also tubes and parts. List sent on request. Alvin J. Fisher, 1,000 Faile St., Bronx, 59, N. Y.

TRADE—12 tube Arlington, superhet. chassis, with 2 12" speakers for Voltohmyst VTVM and pay $25 to boot. Want 25D8 and 50Z7 tube for cash. V. A. Torkildson, 1505 N. 39th St., Milwaukee, Wis.

FOR SALE—Complete line of parts to build electronic photoflash outfits; flashtubes, transformers, photoflash capacitors, etc. Guaranteed. Photo equip. taken in trade. Larry Benedict, 2643 East Dauphin St., Philadelphia 25, Pa.

FOR SALE—RCA Dynam. Demonstrator III, never used, $85; several outdated tube testers and meters in good condition; Also Weston model 676. George Keller, 1420 Newkirk Ave., Brooklyn 26, N. Y.

FOR SALE—7" Transvision television rec. with antenna $150; Aurex hearing aid, like new $50; Perfex 55 f 2.8 lens, minlarger, viewlex projector & 40" screen, $150. Excellent condition. E. C. Landwehr, 121 Garrison Ave., Jersey City 6, N. J.

SWAP—Ghirardi's Radio Physics Course, 2nd edition, like new; Midland Radio Course, 31 lessons (on xmtrs & elements of electricity). Want old stamps, radio parts or what have you? Charles Remick, 2904 Lebanon, El Paso, Texas.

FOR SALE—Brand new 5", model 195, Hickok oscillograph, cost $132, will sell for $115. Edwin A. Gruneich, Buffalo, N. Dak.

FOR SALE OR TRADE—Tubes, complete sound system, and RCP tube tester in good condition. Want 1 milleamperemeter, ham equip. and photo equip. All letters answered. Smith Radio Service, R. D. 2, Beaver Falls, Pa.

FOR SALE—RCA sound amplifier, 4 inputs, new, $80; Teletone radio, 5 tubes, white cabinet, $10; Sentinal 5 tube new, white and red, $12.95; J36 Bug key, $4. Also tubes. Write your needs. Walter Keith, 201 W. 2nd St. N. Newton, Iowa.

FOR SALE—10" super dynam. speak; 5" Utah electrodynam. with 3,000 ohm field; 4" PM speaker and transformer; all in good condition. Also Trutone Service Manual, Vol, 2. Make Offer. Lynford Erway, 351 Prospect St., Niagara Falls, N. Y.

FOR SALE—Weston model 676 tube tester in good working condition, $10. Shipped collect. Rutgers Radio Repair Co., 7 Bartlett St., New Brunswick, N. J.

FOR SALE—NRI Radio Course with kits, $38.50; NRI Service Manual, $10; Coyne Trouble Shooting Manual, $4.50; NRI professional tube tester, $39.50. James Coakley, 111 Rose Hill, Anderson, S. C.

FOR SALE—Hickok xtal controlled AM-FM sig. gen., model 288X, in perfect condition, $135. John S. Arico, 2939 - 167th St., Flushing, L. I. N. Y.

SWAP—Stamp collection. Some mounted in loose leaf books, many U.S. unused, also in blocks. Want Kodak Medalist II, Speed Graphic coupled R. F. syn. flash, or what have you in photo equip.? Columbia Radio Service, 322 Bessemer Bldg., Sixth St., Pittsburg 22, Pa.

FOR SALE—Like new Sunkraft lamp, $35; Zenith console radio, 3 bands, modern cabinet, perfect, $40; Cinemaster II, new 8mm camera, f 2.5 lens, $47.50. Philip J. More, 4,800 North Lawndale Ave., Chicago 25, Ill.

WANTED—A Velocity microphone, model V.R.H.F. made by Selector Mfg. Co. Grillo Music Box, 58 Forest St., Milford, Mass.

SELL OR SWAP—NRI Radio Course (1946-47), $50, less kits, tester, and power pack, $35; Knight wireless phono oscillator, $7.50, less tubes $6.00. Want 10" or 12" P.M. speakers with baffles or carrying cases, high imp. mikes, etc., or what have you? Gerard W. Thibodeau, Central Maine San., Fairfield, Maine.

FOR SALE—Hallicrafters S-20-R rec., $45. Arthur Catlin, Stanton, Nebraska.

SELL OR SWAP—QST's Jan., 1932 to Dec., 1945, complete in good condition. Breting 12 rec. fair condition. Need good sig. gen. and UTC S-47 xformer (or Thordarson T-19P59). H. E. Royer, 80 Liberty St., Westminster, Md.

FOR SALE OR SWAP—Tripolet model 1200G V.O.M; Chicago Industrial Instrument V.O.M.; Black & Decker model 458 "Heavy duty" 1/4" 250V AC-DC drill; and one McElroy "Bug". Want small pistol, typewriter, or what have you? Cecil Mick, 1029 Ledford St., Harrisburg, Illinois.

FOR SALE—7" Transvision television rec. Cost $159.50 in kit form. Assembled and in good working order. No reasonable offer refused. T. H. Clark, 1821 N. Caroline St., Baltimore 13, Md.

FOR SALE—New Brush model PL-20 crystal phono pickup. Never used, still in orig. package. Price $17. George J. Dryer, 300 Electric Bldg., Buffalo 3, N. Y.

FOR SALE OR TRADE—National NTE/B all band phone/cw exciter-xmitter; Hallicrafter SX25 rec.; BC610 antenna tuner unit AT3; Philco all-wave radio console; pair RK65's; crystal ovens. What have you? George Pasquale, 9421 Thornhill Road, Silver Spring, Maryland.

FOR SALE—G.E. TC-3A tube checker, brand new portable model, illuminated meter, $45. E. C. Smith, 2821 N. Wood Ave., Linden, N. J.

FOR SALE—Approved A-200 sig. gen., $27.50; Supreme 599 tube tester and VOM, $49.50; S40 Hallicrafters, $59; Sylvania type 140 tube tester panel mount. no case, $55. All in good cond. with instruc. Take Rider's 11-12-13-14 in trade. D. L. Roberts, 609 E. Mo. St., Kirksville, Missouri.

SWAP—4 x 5 Elwood enlarger less lens and baseboard, good condition. Want radio equip. or communications set. William O. Saari, 145-36 123rd Ave., So. Ozone Park, New York 20, N. Y.

FOR SALE—12" Techno-Craft overhead recording mechanism, cuts 110 lines per inch, Astatic X26 crystal cutter, like new $45. Arthur W. Crampton, Jr., 109 Bartlett Ave., Arlington, Mass.

FOR SALE—Well established Radio and Electrical Sales and Service. Outstanding franchises for radio, records and appliances. Only service man in large area. Double store, drive-in basement, large apartment second floor. Marathon Radio Service, Marathon, N. Y.

FOR SALE—NRI vacuum tube volt meter, with test leads and instructions for use. Less batteries, $17 plus postage. Frederick A. Roessler, 6029 - 71st Ave., Ridgewood 27, N. Y.

WANTED—Overhead cutting mechanism and recording turntable for 16" records. All inquires answered. Dean Moore, P.O. Box 1, Jackson Heights, N. Y.

FOR SALE OR TRADE—300 copies of Pop. Science, Pop. Mechs., Radio News, Radio Craft, etc. New Clarion 3-way portable, lists for $44.95. Trade all for commun. set similar to Hallicrafters S-53 or what am I offered? Harold Howard, 203 E. Auglaize, Wapakoneta, Ohio.

WANTED—Service manual for army surplus receiver ARR-7. Needed badly. E. L. Kuykendall RR 5 Box 287, Riverside, Calif.

SELL OR TRADE—New 150W NBFM-CW, all band, custom built xmitter. Rack mounted grey crackle finish, up to 350W with suitable final tubes. Complete. Want HQ129X, SX43, NC173, or ? Jim Rector, 3555 W. 109 St., Inglewood, Calif.

SELL OR SWAP—110 New tubes, various types, write for list. Want Hallicrafter S-38 or modern make short wave recvr. in good condition. Selling price $55. Glynn McCready, 5240 N. E. 42nd Ave., Portland 13, Ore.

FOR SALE—Two new Navy surplus TBY-8 transceivers with large quantity of spare equip. Each packed in chest with mikes, keys, earphones, tubes, aerials, manuals, and batteries. Bert Rudolph, 226 Pajaro St., Salinas, Calif.

FOR SALE—Tubes: 6V6 metal, 1-49 65c ea., 50-99 60c ea., 100 or more 55c ea. 5U4G tubes, 1-9 45c ea., 10-49 40c ea., 50-99 35c ea., 100 or more 30c ea. All new Kenrads in orig. cartons. Nobo Company, Dept. 14, West Medford 55, Mass.

SALE OR TRADE—Philco 088 sig. gen.; Confidence royal tube tester with analyzer; C. H. Foth Co. Danzig 8X binoculars with case. W. R. Vaughn, 534 Forrest St., Harrisburg, Pa.

SALE AND TRADE—BC-604-DM FM transmitter with dynamotor, $15. Trade SCR-284 xmitter and rec. with spare tubes and a crystal for a BC-312, BC392, or BC-348 rec. in good condition. Charles W. Knoops, 627 Eleanor, Saginaw, Mich.

FOR SALE—Tubes 50% off list; Rider manuals 12, 15, 16, all for $39; Fada FM converter, new $24; new 8" electric fans, $4.50. Academy Radio, 1801 Mott Ave., Far Rockaway, N. Y.

FREE BOOK—"Getting The Most Out of Life," with each special 7 months Introductory Subscription to Reader's Digest magazine for only $1.00. Fred Geyer, 2447 Cortland St., Chicago 47, Ill.

WANTED—Used Philco all wave table model, No. 38-623 2V superhet, clean cabinet and suitable for AC conversion. Floyd Nixon, Apt 6, 4170 Lindell Blvd., St. Louis 8, Mo.

SWAP—Pioneer Gen-E-Motor, input 9V, output 450V; "Bullet" class B model airplane eng., timer, condenser, and coil; Triplett model 666 VOM for Amertran 6,200 VCT at 700 MA, 110V/60 cyl. transformer. Kenneth A. Weimer, 2970 N. Druid Hills Rd., N. E. Atlanta, Ga.

a "plug"

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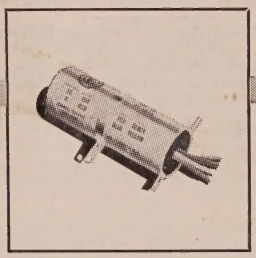
C-D says: Many thanks for your compliments, Harold. We feel well rewarded when servicemen like yourself write us such fine C-D testimonials daily of their own accord.



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